PATENT SPECIFICATION

DRAWINGS ATTACHED

891,860

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COMPLETE SPECIFICATION

Improvements in or relating to Paper Making Machines

We, BELOIT IRON WORKS, of Beloit, Wisconsin, United Sates of America, a corporation organised and existing under the laws of the State of Wisconsin, United States of America. Do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a water removal device for a paper machine, and more particularly to an improved belt construction and support therefor for dewatering a suspension of paper stock flowing on the surface of a Fourdrinier type wire overlying the belt.

An object of the invention is to provide an improved Fourdrinier wire supporting belt and suction box structure capable of applying a continuous suction to dewater a web of paper deposited on the surface of the wire, and to apply a uniform suction over the width of the web.

According to the present invention, an apparatus for extracting water from a paper stock carried on a Fourdrinier wire comprises a suction box the upper surface of which is provided with draining openings and serves to support an endless belt carrying the Fourdrinier wire, the outer surface of the endless belt having rows of channels, the rows extending longitudinally of the endless belt, the channels extending transversely of the endless belt, the channels of each row extending into between the channels of one or more adjacent rows, and the suction box being arranged to extract water from the paper stock through the channels, through apertures extending from the channels through the endless belt, and through the draining openings.

The invention will be more readily understood from the following description of the embodiment thereof illustrated in the accompanying drawings, in which:—

Figure 1 is a side elevational view shown partially in diagrammatic form, of a paper web dewatering mechanism adapted for use with a Fourdrinier type of paper-making machine embodying the principles of the present invention;

Figure 2 is an enlarged, detailed, top plan view showing the arrangement of the top of a suction box for the dewatering mechanism;

Figure 3 is an enlarged, detailed, vertical sectional view taken along line III—III of Figure 5 of the drawings;

Figure 4 is a vertical sectional view taken substantially along line IV—IV of Figure 2, and including a suction belt embodying the principles of the present invention;

Figure 5 is a top plan view of a portion of the suction belt showing the arrangement of the top surface; and

Figures 6, 7 and 8 are vertical sectional views similar to Figure 4, and illustrating different positions of adjustment for changing the deckle edge of the paper web.

As shown on the drawings:—

As illustrated in Figure 1, the mechanism in general for dewatering a paper web on a travelling forming wire W, which in the present preferred embodiment, is supported by a looped belt 11 having molded grooves or channels in the upper surface with ports opening to the lower surface, as will be explained in detail in connection with Figures 3, 4 and 5.

The looped belt 11 travels over a suction box 12 and is supported on the top 13 thereof for the run 11*a*, during which time the dewatering occurs. A salient feature of the present invention is the improved dewatering effect which can be achieved in the improved construction of the belt and suction box which makes it possible to provide a unitary

[*Price* 4*s*. 6*d*.]

suction box. This greatly reduces the space required for the dewatering phase of operations in the entire paper-making process, and obviates the necessity of providing separate suction boxes with supporting table rolls and/or spaces therebetween.

The looped suction belt 11 is carried on conventional rolls 14 and 16, respectively, and guide rolls 17 and 18 are positioned to support the lower run 11*b* of the belt. The guide roll 18 may be supported and operated so as to be pivotal about one end, with the other end moving in the directions indicated by the arrows 19 and 21. With this operation of the guide roll 18, the lateral position of the belt 11 can be accurately controlled and guided so as to maintain the belt in a positive lateral position with respect to the suction box 12. This is important in insuring that the belt 11 will have a fixed lateral position for purposes of alignment of drain passageways, as will later become more apparent.

A suspension of paper stock is let onto the travelling wire W from a headbox (not shown) in the usual manner. Suitable connections, not shown, are provided for the drainage of water from the suction box 12, and for applying a vacuum thereto.

The belt, as particularly shown in Figures 3, 4 and 5, is formed of a moulded material, such as rubber, which is well adapted for forming the improved top surface conformation for dewatering and drainage, as will be described, and which has reduced friction between its lower surface 20 and the top 13 of the suction box when wetted with the water being drawn from the paper web, which, with the wire cloth W, lies on the upper surface 23 of the belt.

Formed in the upper surface 23 is a plurality of grooves or channels, as illustrated at 24, 26, 27, 28, 29, 31, 32 and 33. Figure 5. These channels are elongated with straight sides and extend laterally across the belt 11. The channels are arranged in straight rows extending laterally across the belt 11, and as illustrated in Figure 5, channels 26 and 33 illustrate the end of one lateral row, channels 27 and 31 illustrate the end of another row, and channels 28 and 32 illustrate the end of still another row.

The channels may also be regarded as being arranged in longitudinal rows. The channels of each longitudinal row, however, are staggered so as to extend half-way into the adjacent row. For example, channels 33, 31 and 32 lie in one longitudinal row (the longitudinal row extending in the direction of belt travel, as indicated by the arrow 34). The channels 26, 27 and 28 may be regarded as forming another longitudinal row. It will thus be noted that the channel 31 extends laterally beyond its row into the other row, and that the channels 26 and 28 extend laterally into the row adjacent to their row. It will be understood that channels 26 and 28, as well as channels 33, 31 and 32, represent channels of full length. The channel 27 is only one-half length in order to form an even edge of the channel area, with the edge of the main channel area being defined by the ends 26*a*, 27*a* and 28*a*.

The channels are thus arranged so that they alternately overlap. In other words, in a longitudinal direction, each full length channel, such as channel 26 or 28, is offset from its adjacent full length channel, such as channel 31, to overlap one-half of said adjacent full-length channel. This will cause drainage of an area in both lateral directions, since the drainage ports for each channel are located at the centres of the channels. The drainage port for the channel 26 is shown at 36, the drainage port for the channel 28 is shown at 38, and the drainage port for the channel 31 is shown at 39. The drainage port for the channel 27 is shown at 37.

Each drainage port extends downwardly from the base of the channel and opens through the lower surface 20 of the belt to communicate with the suction box for the drainage of water. As illustrated by the port 38, a lower oblong straight walled portion 38*a* opens through the lower surface 20 of the belt, and the port is provided with an upper outwardly flaring tapered portion 38*b* which is wider than the channel 28 which it drains. Likewise, the port 36 is provided with a straight walled lower portion 36*a* which opens into the suction box from the lower surface 20 of the belt, and an outwardly flaring tapered upper portion 36*b* which is wider than the channel 26 which it drains. The drainage ports are so located as to be opposite the ends of the channels in an adjacent lateral row. Thus, the ports 36 and 38 are opposite the ends 27*a* and 31*a* of the channels 27 and 31 of the lateral row intermediate the rows of channels 26 and 28. This arrangement of the ports improves drainage from each of the channels and assures uniform and improved suction on the web for improved and uniform dewatering. Thus, the port 39 for the channel 31 is at the midpoint of the channel 31, and located opposite the ends of the channels of the adjacent lateral rows, that is, the ends of channels 26 and 33, and the ends of channels 28 and 32.

This configuration furthermore provides a contact surface for the supported Fourdrinier wire, having minimum area, so as to offer minimal resistance to the removal of water from the web being formed.

Each of the channels has an improved shape for improved suction and drainage. As illustrated in Figure 3, the channel 26 has a base planar portion 26*b*. Rising

upwardly and diverging outwardly from the planar base are inclined side walls 26*c* and 26*d*. Rising upwardly from the upper edges of the side walls 26*c* and 26*d* are vertical side walls 26*e* and 26*f* which extend to the top surface 23 of the belt. Inasmuch as each of the channels is of similar construction, only one need be described in detail, with each having an identical cross-sectional shape.

Outwardly of the aforedescribed channels are second shorter channels or deckle channels, as illustrated at 41, 42, 43 and 44 in Figure 5. The deckle channels are shorter and are of substantially the same cross-sectional configuration with a planar base 41*a* and outwardly diverging side walls 41*b* and 41*c* and straight vertical side walls 41*e* and 41*f* adjacent the top surface of the belt. Since the deckle channels are shorter and taper to a point at their ends, they have a generally oblong shape, as contrasted with the longer channels which have straight sides. The deckle channels are arranged so that they extend in longitudinal rows with channels 41 and 43 being located in the outer row and channels 42 and 44 located in the inner longitudinal row. The deckle channels are also arranged so that the channels of the outer row are aligned laterally with the lateral rows of the longer channels, and the deckle channels of the inner rows are between the rows of the longer channels. Thus, deckle channel 41 is aligned with the row of the longer channel 26, and deckle channel 43 is aligned with the row of the longer channel 27. Deckle channels 42 and 44 extend between the rows. Their inner ends 42*a* and 44*a* project into the longitudinal rows of the longer channels, or in other words, project beyond the ends 26*a*, 27*a* and 28*a* which define the edge of the area of the longer channels.

Each of the deckle channels is provided with a port opening from the base through the lower surface of the belt. Thus, channels 41, 42, 43 and 44 have drainage ports 48, 49, 51 and 52 opening from the bottom thereof.

In determining the width of the paper web formed on the upper surface of the belt, vacuum is selectively applied to the inner row of deckle channels and the outer row of deckle channels. For a paper web of narrow width, the vacuum from the suction box is cut off to the ports 49 and 52, and the rest of the row of inner deckle channels, and also from the outer row of deckle channels. For an intermediate width of paper web, vacuum is applied to the inner row of deckle channels. For a full wide width of paper web, vacuum is applied to both rows of deckle channels.

The top 13 of the suction box 12 which functions to support the travelling belt 11 and apply suction to the channels in the surface, is illustrated in detail in Figures 2 and 4. At the end of the suction box top is shown a plate 53, being attached to the suction box by screws 54 and 56. Extending longitudinally along the top of the suction box and attached to form a sliding support surface for the belt 11, are bearing strips, as illustrated at 57, 58 and 59. The bearing strips are spaced apart and extend parallel to each other. Running longitudinally along the top of each bearing strip are grooves, as illustrated at 57*a* and 57*b* for the bearing strip 57, and 58*a* and 58*b* for the bearing strip 58. These grooves reduce the area subjected to friction and admit water (or the like) for lubrication of the belt sliding over the bearing strips.

The grooves 57*a*, 57*b*, 58*a* and 58*b* provide channels through which water (or the like) may be introduced under pressure sufficient to counter the effect of the atmospheric pressure acting on the wire and the belt. By supplying a slight excess of pressure, a film of water flows from the grooves into the drainage holes 57*c* and 58*c*, lubricating the passage of the belt 11 over the surface of the suction box structure 12. Furthermore, such water film effectively seals against the ingress of atmospheric air.

Preferably these grooves are sized to occupy approximately fifty per cent of the "land" area remaining around the suction holes.

Each bearing strip has a series of drainage openings, such as illustrated at 57*c* and 58*c* for the bearing strips 57 and 58. These openings are in lateral alignment with the drainage ports in the belt, and as illustrated in Figure 4, the ports 37 and 38 in the belt draining through the rows of ports 57*c* and 58*c*. The bearing strips may be formed of various materials, and, by way of example, may be formed of metal or of a hard wood, such as maple, or other material which has good wearing and friction characteristics for the purposes desired.

The bearing strips are supported by underlying support strips such as illustrated at 61 and 62. The support strips extend in spaced parallel relationship longitudinally along the top of the suction box, and form slots such as illustrated at 63 and 64, therebetween, which are in communication with the rows of holes through the bearing strips. The support strips are tied to each other by lugs with strips 61 and 62 tied by lug 68. The support strip 61 is tied to a side support plate 71 by lug 69. Screws such as 72, 73, 74 and 76 extend down through holes in the bearing strips and support strips to draw the lugs, support strips and bearing strips together.

On top of the support plate 71 is a deckle strip 79 which is mounted so as to slide laterally to a first, second or a third posi-

tion. Lateral movement of the deckle strip 79 determines the width of the paper web being formed. The positions are illustrated in Figures 6, 7 and 8. In the first position as illustrated in Figure 6, the widest web is formed. In the second position, as illustrated in Figure 7, the narrowest web is formed. In the intermediate position, as illustrated in Figure 8, a web of an intermediate width is formed.

As illustrated in Figure 4, the deckle strip 79 has a laterally extending slot 79*a* through which extends a guide bolt 80 threaded into the support plate 71. An upstanding lug 79*b* is positioned at the outer edge of the deckle strip 79, and is threaded to receive a rotational adjustment bolt 81. The bolt is rotatable in a support lug 82 which is secured to the support plate 71, and rotation of the bolt will permit adjustment of the deckle strip 79. A lock nut 83 threads against the lug 79 to lock the position of the deckle strip. It will be understood that a plurality of adjustment bolts 81 may be provided along the deckle strip for uniform adjustment of the deckle strip.

The deckle strip is provided with three rows of holes, with an inner row illustrated at 84, an intermediate row at 86, and an outer row at 87, as illustrated particularly in Figures 2 and 4. These rows of deckle holes have blocking areas therebetween with a blocking area 88 between the holes 84 and 86 and a blocking area 89 between the rows of holes 86 and 87. The holes and blocking areas therebetween either make communication or block communication between the slots 77 and 78 in the support plate and the inner and outer rows of deckle channels in the belt.

As illustrated in Figure 6, the deckle plate 79 is positioned in its innermost position so that the rows 86 and 87 of deckle holes provide communication between the slot 77 and the port 52, leading to the channel 44 which is in the inner row of deckle channels. The deckle holes 87 provide communication between the slot 78 and the plate 71 and the port 51 leading to the deckle channel 43, which is in the outer row of deckle channels.

Figure 7 illustrates the deckle strip 79 moved outwardly to the next adjusted position. In this position, which forms the narrowest web of paper, the slots 77 in the support plate 71 are blocked by the area 89 and the inner row of deckle ports in the belt is blocked by the area 88.

As illustrated in Figure 8, in the outermost position of the deckle plate 79, the blocking area 89 still blocks the outer slot 78 in the support plate, but the inner slot 77 communicates through the inner row of deckle holes with the port 52 leading to the channel 44 which is in the inner row of deckle channels. In either position of the deckle plates 79, a uniform web of paper is formed to the deckle edge because of the improved and more uniform drainage path for the water being drawn from the web.

In operation, the looped suction belt 11 is driven over the top 13 of the suction box 12, and water is drained from a web formed by a deposit of paper pulp suspension on the top surface of the wire W. The web is dewatered and compacted by water draining from the overlying wire into the main channels which are formed in the top surface of the belt 11, and which are arranged in lateral rows, as illustrated by the channels 26 and 33, and are arranged in longitudinal rows, as illustrated by the channels 33 and 31, with alternate channels such as 31 offset one-half length to extend into the adjacent row. Each channel is provided with a centrally located drainage port, as indicated by the port 39 for the channel 31. The edge of the web is formed by the deckle channels which are arranged in an inner row, as illustrated by the channel 44, and an outer row, as illustrated by the channel 43. Variation of the deckle edge is obtained by positioning the deckle strip 79 in one of the positions of Figures 6, 7 and 8, to provide communication between the inner and/or outer rows of channels in the belt, and the slots 77 and 78 in the support plate 71.

Thus it will be seen that we have provided a dewatering mechanism providing for improved more uniform and more rapid drainage which achieves the attendant advantages hereinabove set forth. The apparatus makes possible the provision of a belt and suction box arrangement in a paper forming machine which has reduced friction between the belt and suction box and which permits a more compact structure for the machine in providing a much shorter length of travel for the dewatering operation. The provision of a unitary suction box without intermediate supporting table rolls or spaces achieves other attendant advantages in more compact equipment, and enables the provision of a simplified machine in which the belt may be more easily changed.

WHAT WE CLAIM IS:—

1. An apparatus for extracting water from a paper stock carried on a Fourdrinier wire comprising a suction box the upper surface of which is provided with draining openings and serves to support an endless belt carrying the Fourdrinier wire, the outer surface of the endless belt having rows of channels, the rows extending longitudinally of the endless belt, the channels extending transversely of the endless belt, the channels of each row extending between the channels of one or more adjacent rows, and the suction

box being arranged to extract water from the paper stock through the channels, through apertures extending from the channels through the endless belt, and through the draining openings.

2. An apparatus as claimed in Claim 1, in which, except for every other channel in the outer longitudinal rows, each channel is provided with an aperture in the gap between the adjacent channels of the adjacent longitudinal rows.

3. An apparatus as claimed in Claim 1 or 2, in which each channel has flat side walls extending perpendicular to the surface of the endless belt, inclined side walls extending from the flat side walls and joined by a flat surface parallel to the surface of the endless belt, the flat surface being of smaller width than the channel and the channel being tapered at each end.

4. An apparatus as claimed in Claim 1, 2 or 3, in which each channel has only one aperture which, except for every other channel of the outer longitudinal rows, is located at the midpoint of the respective channel.

5. An apparatus as claimed in any preceding claim, in which the channel end of each aperture is enlarged to a width greater than the width of such channel.

6. An apparatus as claimed in any preceding claim, in which the top surface of the suction box comprises a bearing plate having rows of openings spaced to lie beneath the longitudinal rows of apertures and in which the bearing plate is supported by a support plate provided with openings through which the bearing plate openings communicate with the interior of the suction box.

7. An apparatus as claimed in Claim 6, in which the rows of channels are located between longitudinal rows of deckle channels in the endless belt, the bearing plate comprising a pair of side portions which are adjustably movable below the edges of the endless belt for selectively connecting the rows of deckle channels with respective openings in the support plate.

8. An apparatus as claimed in Claim 7, in which two longitudinal rows of deckle channels are provided at margins along each side of the belt, holes in each bearing plate are spaced to lie beneath the rows of deckle channels and each bearing plate side portion is provided with three rows of passages spaced to allow movement of the bearing plate side portions to block the openings in the support plate, to connect the inner rows of deckle channels with the respective openings in the support plate or to connect both rows of deckle channels to the respective openings in the support plate.

9. An apparatus as claimed in Claim 6, 7 or 8, in which the support plate comprises a plurality of support strips, the openings being slots defined by the sides of the support strips, and in which the bearing plate comprises a plurality of bearing strips each of which is supported by a respective pair of the support strips.

10. An apparatus as claimed in any preceding claim, in which rolls are provided beneath the endless belt for supporting the lower run thereof.

11. An apparatus for extracting water from paper stock carried on a Fourdrinier wire as claimed in Claim 1 substantially as described hereinbefore with reference to the accompanying drawings.

12. An endless belt substantially as hereinbefore described with reference to the accompanying drawings.

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Fig 1

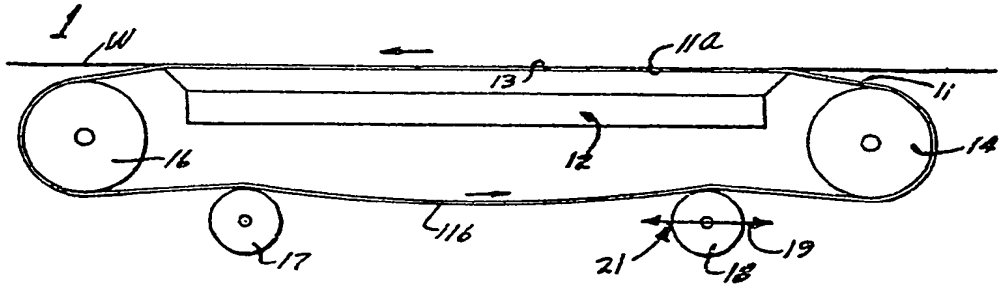


Fig 3

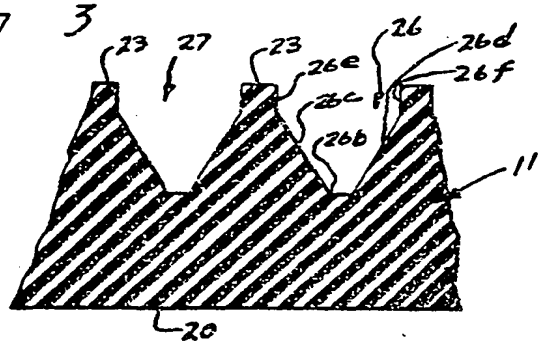
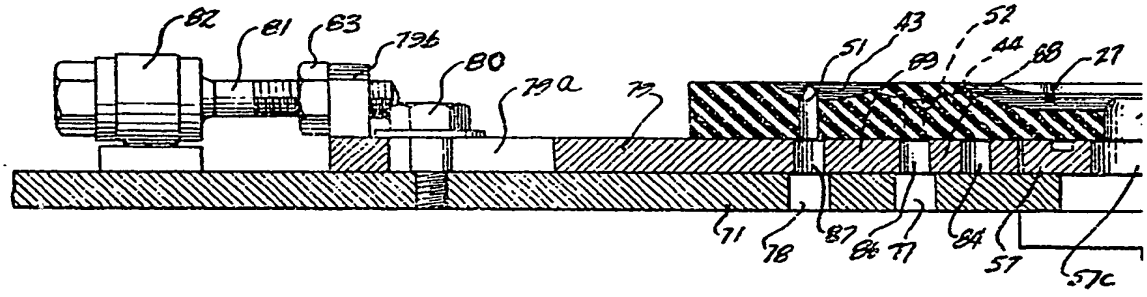


Fig 4



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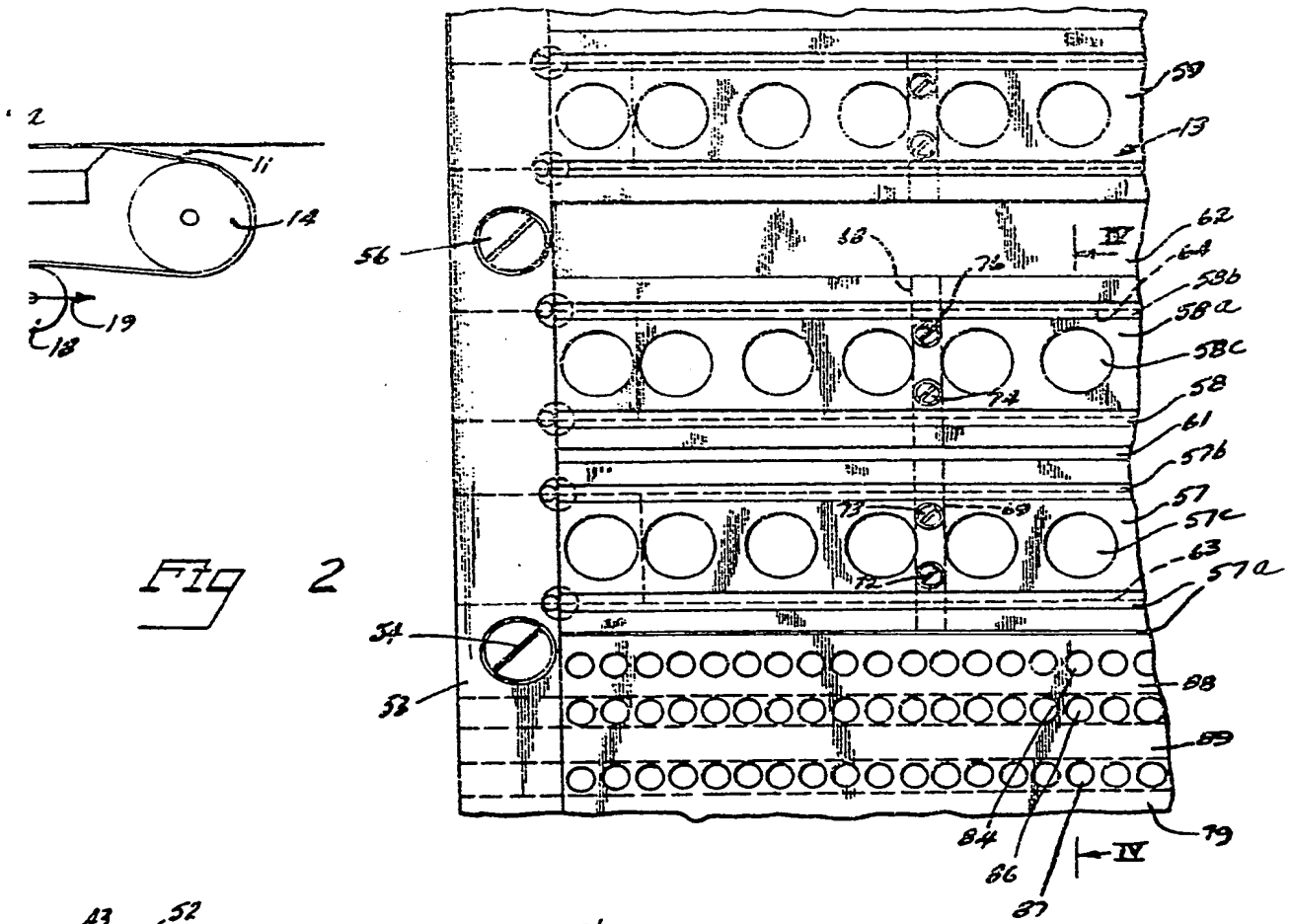

Fig 2

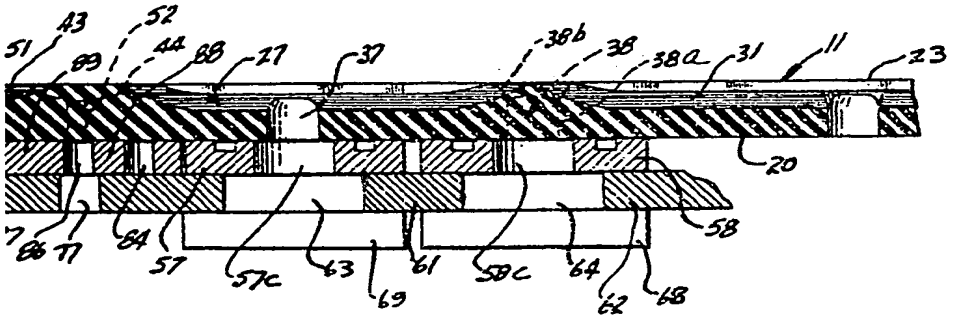

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Fig 1

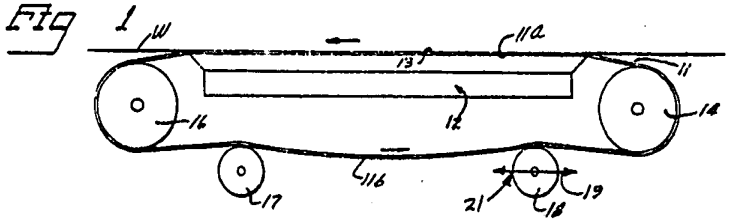


Fig 3

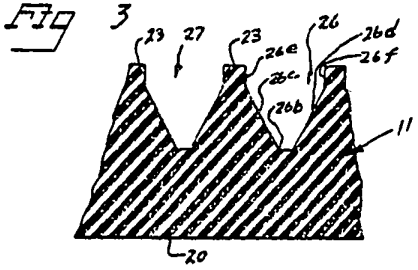


Fig 2

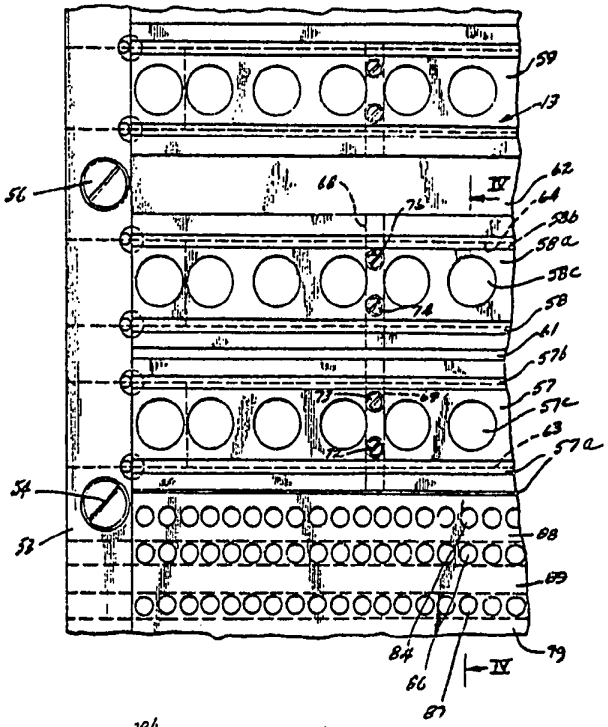


Fig 4

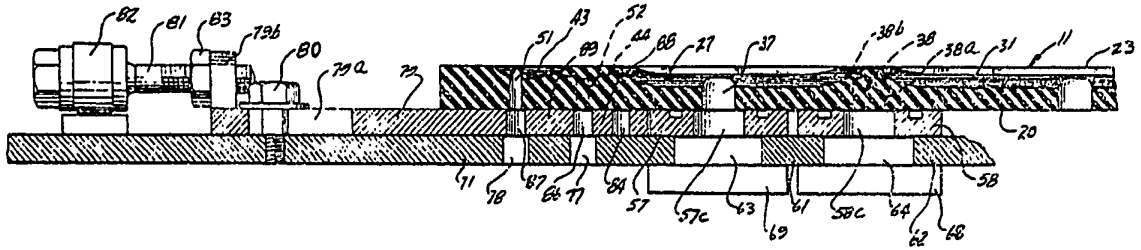


Fig 5

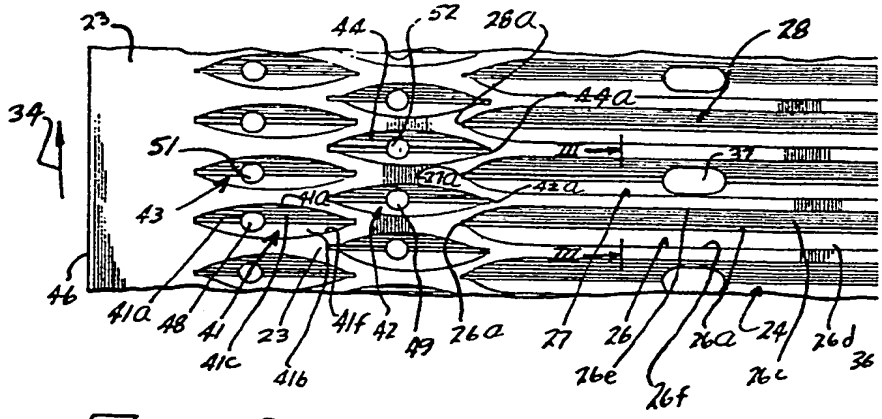


Fig 6

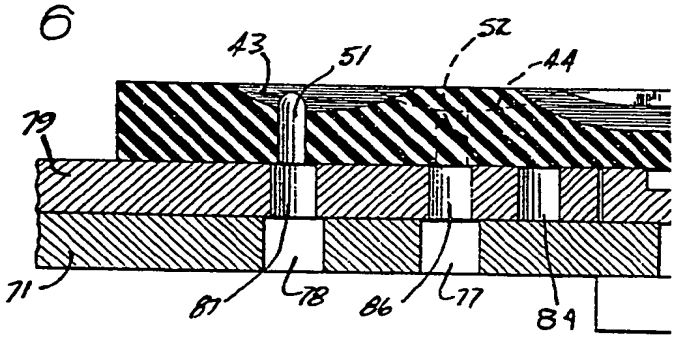


Fig 7

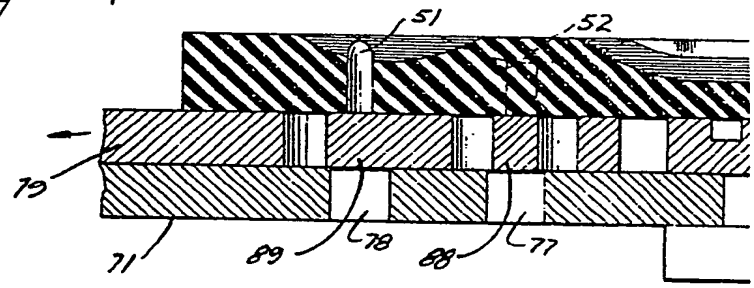
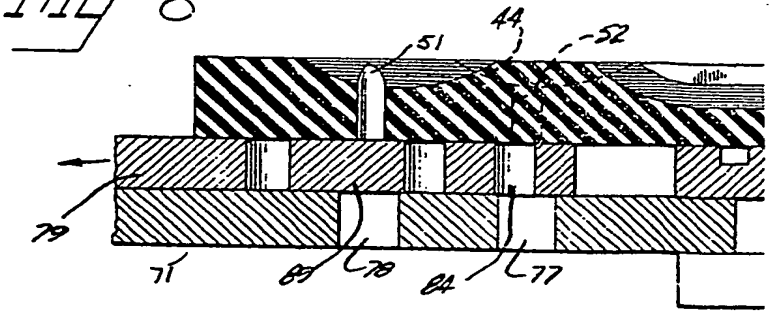


Fig 8



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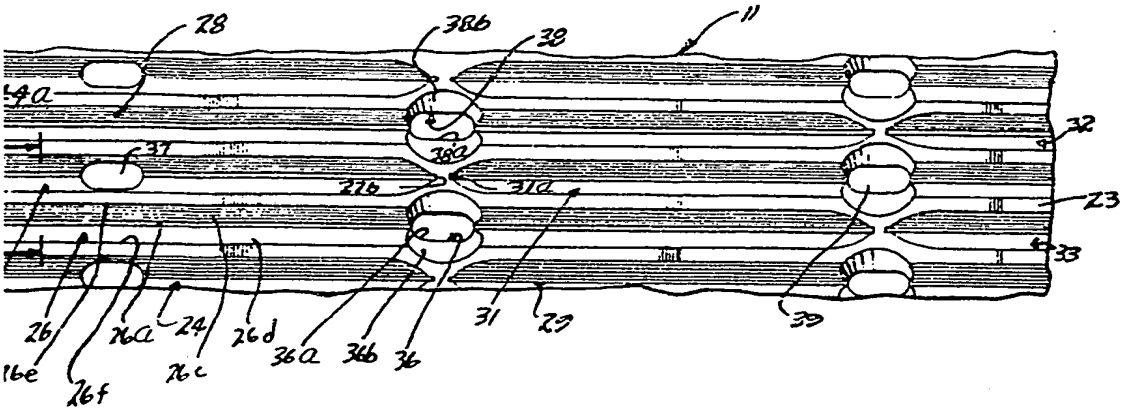

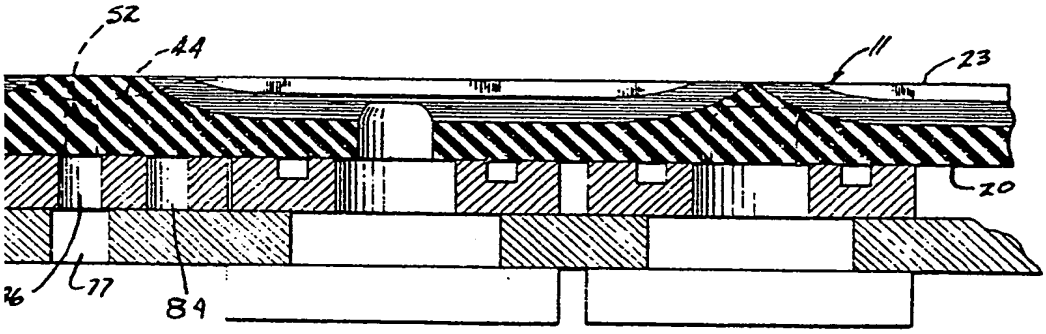

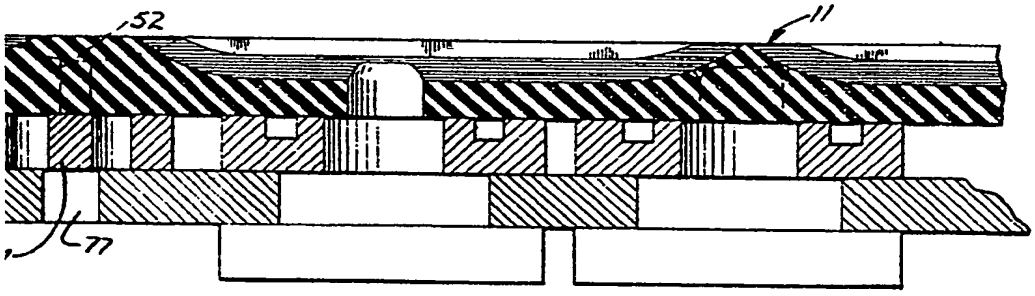

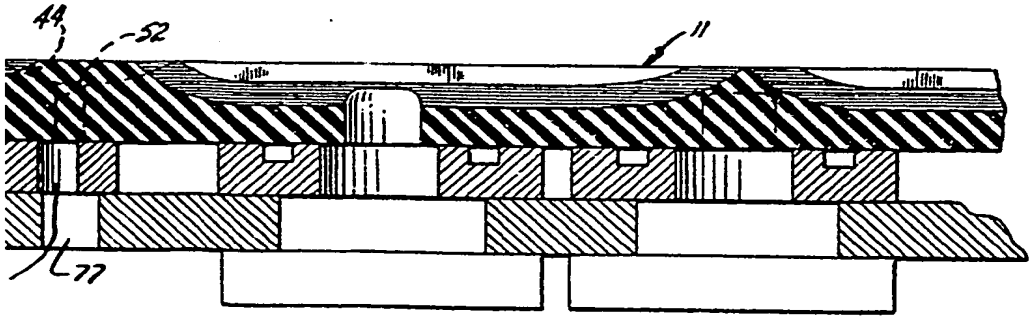

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Fig 5

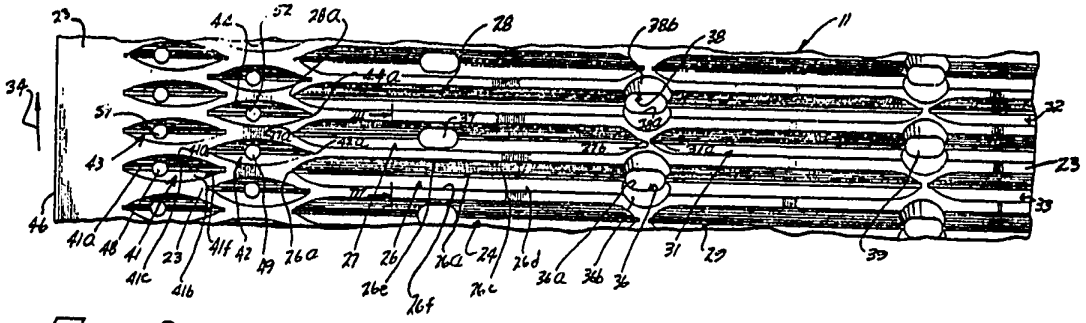

Fig 6

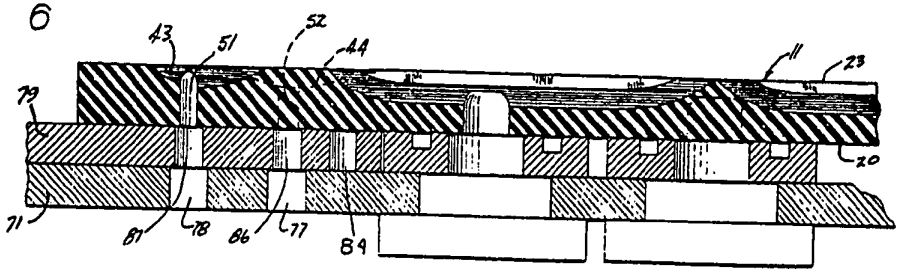

Fig 7

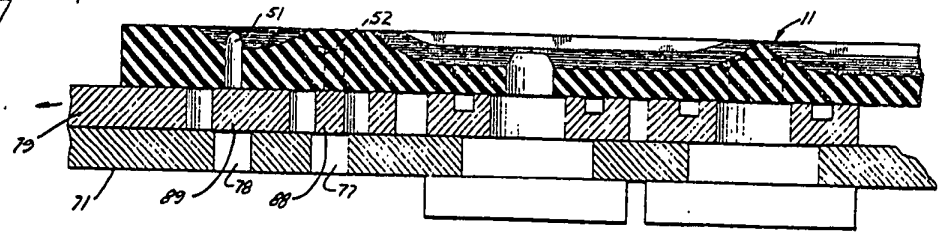

Fig 8